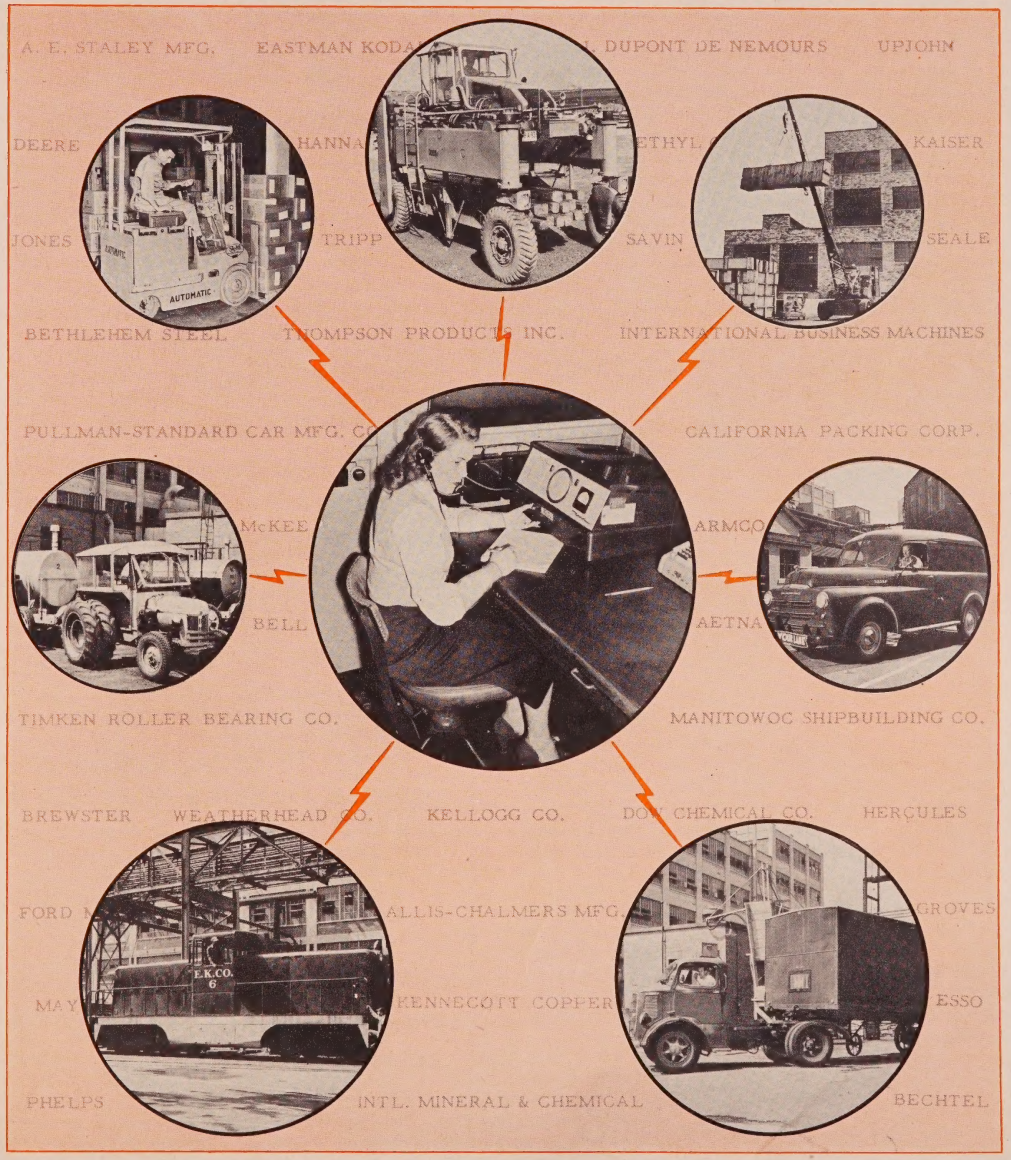
Communications & Electronics Division

Motorola NEWSGRAM

Mar-Apr. 1952



Industrial Communications Issue

TIC-TALK

TECHNICAL INFORMATION CENTER

AUDIO QUALITY IN MOBILE COMMUNICATIONS

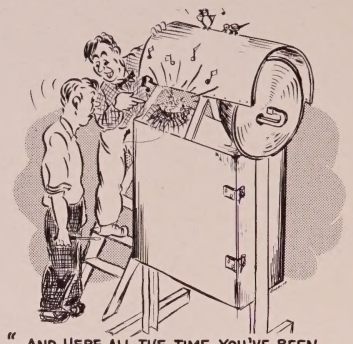
No one will argue that good audio quality is not essential for effective police radio communications and for all mobile radio communications. The argument starts when you attempt to develop general agreement on what constitutes good audio quality. Some observers want broadcast quality; others want high intelligibility and insist upon obtaining it with high frequency emphasis; others object to the high frequency hiss and noise and want rounded-off highs and plenty of low frequency. The only point one can be sure about is that there is a substantial difference of opinion, and an examination of the fundamentals of the argument will show that each man is right for some conditions of reception. Arguments develop because there is a misunderstanding of the basis upon which the different points of view rest.

From my personal observation, I feel that the greatest degradation of audio quality in the mobile service comes from one of the following causes: (1) Overmodulation or over-deviation beyond the acceptance characteristics of the receiver. (Varies widely with signal level at receiver input). (2) Off-frequency adjustment between the transmitter and receiver. (3) Improper balance of the whole system, including microphone, pre-emphasis and de-emphasis networks, and the loudspeaker characteristics and location. (4) Over-compression to provide maximum intelligibility through the greatest noise.

At Motorola, we attempt to set up the best combination of compression, microphone characteristics, pre-emphasis, de-emphasis and loudspeaker performance to give the best all around practical balance for all field conditions. We can give you crisp speech, heavy compression or emphasized bass, if you desire something to satisfy special conditions.

We are searching constantly for the most effective integration of system elements to yield the greatest possible accuracy of message handling. Use the recommended combination of transmitter, microphone, receiver and speaker for best results; they are balanced units with suitably related characteristics.

Dan Noble



"...AND HERE ALL THE TIME YOU'VE BEEN TELLING ME IT WAS CROSS TALK..."

The

NEWSGRAM

Copyright, 1952

Published by

MOTOROLA INC.

Technical Information Center

Communications and Electronics Division

4545 Augusta Blvd. Chicago 51, Illinois

IN THIS ISSUE

INDUSTRIAL FEATURES

Allis-Chalmers Plant 4–5
Industrial Radio Growth 6–7
Gardner Denver Company 8
Thompson Products 9

GENERAL FEATURES

Radio for Car Hops 10
Michigan Physician's Radio 11
Denver Crash Coverage 12
Kans.—Neb. Natural Gas 13
Radio for Va. Railroad 14–15
Arizona Photo Story 16–17

PHOTO GALLERY 18–19

TECHNICAL NOTES 20–29

NEWS PAGES

Late News 3
General News 30
Regional News 31

NEW YORK CITY FIRE RADIO NET NOW OPERATING

Motorola Completes World's Largest System

The world's most extensive and complete fire department 2-way radio system, built by Motorola for the City of New York Fire Department, is now completed and in operation.

A total of 660 Motorola mobile units are being used on fire apparatus, sedans, fire boats, maintenance trucks, and other vehicles.

Because the city is, in effect, five cities operating together on a mutual basis, installation of equipment was made only after thorough investigation and planning.

Specifications for the entire system covered 132 pages in addition to the Fire Department's standard printed form of proposals for bids. The contract, covering both the furnishing and installation of the complete 5-borough system, was awarded to Motorola following two years of exhaustive tests.

A detailed story on this installation will be carried in May and June issues of FM/TV Radio Communications magazine and a descriptive picture story of it is planned for a forthcoming Newsgram issue.

R. R. RADIO SALES REACH NEW HIGH

More than 50% of all the railroad radio equipment sold during 1951 was built by Motorola, R. Floyd McCall, Sales Manager in charge of railroad sales, has reported. He expects Motorola's 1952 sales to enjoy an even more dominant position.

The tremendous growth in acceptance of Motorola radio by this industry is graphically illustrated by the fact that at the end of 1950, 28 railroads were Motorola customers. At the end of 1951 approximately 50 railroads had purchased this equipment.

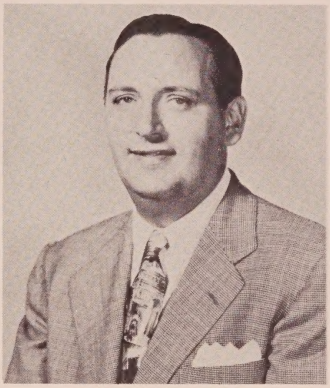
New Parts Dept.

Jipp Moving To West Coast Post; Falls Goes To Southwest Region

The forthcoming opening of a new West Coast Parts and Service Department to be headed by John Jipp, formerly regional manager of Motorola's Communications and Electronics Division's southwest area, has been announced.

Ed Falls, the company's zone manager for Southern California has been selected to succeed Jipp in supervising the region comprising Texas, Oklahoma, Louisiana, Arkansas, and New Mexico.

Ed. Falls



John Jipp

NEWSGRAM NOTES

The City of Los Angeles has Motorola 2-way radio-equipped fire and patrol boats in operation for protection of the harbor area and for catching smugglers, stopping thievery and helping the kids. The operators are long time Navy and Coast Guard officers who know the sea. (They know their 2-way radios too.)

Chicago Medical Civil Defense Communications Corps has gained outstanding recognition for their unrelenting interest in producing the best CD network in the country. Sparkplugs in the organization include Motorola engineers Al Witt, Harry Harrison, Bill McNatt and Lloyd Morris. (Most of the radio equipment, of course, is Motorola too.)

Motorola continues to be the leading manufacturer of Microwave relay equipment with its two 1000-mile systems being the longest fully-operating networks in the world.

Establishment of the new department for service to the Western States will give customers and Motorola Service Stations the same quality service now available east of the Rockies. The new department, to be located in San Mateo, will completely duplicate the Chicago Parts and Service Department.

Jipp became associated with Motorola as a sales representative in 1945 after spending four years as a senior engineer in the Signal Corps Laboratories in Fort Monmouth, N. J. Previously he was with RCA Victor and General Motor's Radio Corporation.

Falls, who has had a total of nine years association with Motorola in various capacities, came back to the company as a Radio Communications Engineer and was assigned to the Southern California area in 1948 after release from the United States Navy where he achieved outstanding success as a Staff Radar Officer.

Mobile Radio Pays Its Own W

How One Company That Had Outgrown Its Materials Handlings Methods Chose Motorola Radio As The Solution

Moving extremely heavy and bulky items such as forgings and castings about a 160 acre plant area can become a highly inefficient operation, Allis-Chalmers of Milwaukee, Wisconsin discovered in analyzing their materials handling problem.

In the past, most movement of large items had been done by railroad car. Over the years the company had built up a system of 14 miles of railroad track and 100 pieces of railroad equipment. Estimates showed that movement of each railroad car cost approximately 75 cents, but to move a car generally required the movement of three or four other cars to get to the one required.

The first step in alleviating the difficulties, and increasing efficiency, was to purchase a selection of two truck-tractors with eight trailers. A study of the problem had determined that platform trucks, because of the long delay time at loading and unloading docks, would be unsuitable for this aspect of Allis-Chalmers operations. It would mean that for each parked truck, each driver would be held long periods of time waiting to move.

By the adoption of truck-tractors and trailers, fewer truck operators were required, and the drivers could move trailer by trailer as required with a minimum of pauses in a day.

However, the company, during the first six months of truck-trailer operation, found it still had one problem unsolved. The dispatchers, many times, were unable to find a truck when it was needed, and often trailers were "lost" after being moved a number of times and could only be located after many telephone calls about the plant, or by a personal inspection trip. Then, it was often necessary for the truck drivers to individually check the trailers to find out whether they were loaded and ready to move.

After only a month of this type of operation, the company installed temporary mobile radio telephones in their trucks to carry them over until delivery of Motorola 2-way radio could be obtained and permanently installed. Even at the toll charges of approximately $250 a month for the temporary installations, the company found that keeping the trailers moving was worth more than the cost.

Mr. T. S. Wilmeth, assistant control manager, writing in the December issue of "Modern Materials Handling," reported that "no more proof was needed regarding the necessity of radio control".

At the present time twenty-two vehicles are controlled from two dispatching points. These include Diesel locomotives, one yard lift truck, two yard derricks, two industrial tractors, one dispatcher's car, one maintenance truck, two pick-up trucks, eight heavy duty platform trucks, and the two truck-tractors which handle eight trailers.

Company figures show that the initial investment for the addition of Motorola radio-equipped truck-trailers will be paid for in less than three years. Mr. Wilmeth reported that these figures alone, however, do not tell the whole story, because there have been additional savings and benefits which cannot readily be expressed in dollars and cents.

An overall simplification of operation has been achieved as a result of deliveries now being made immediately, or at least within hours, which formerly had to be scheduled many days in advance, and there has been a reduction in waiting time throughout all the shops.

The dispatcher receives a call for a truck in the Motor Transportation dispatching area. She will immediately contact by radio an available truck which will proceed directly to the job.

Dispatcher in his radio-equipped car checks conditions at loading docks and storage areas. He can remedy congestion immediately by use of the radio.

Dispatching center in the Allis-Chalmer's scale house from which Motorola radio-controlled railroad equipment is directed.

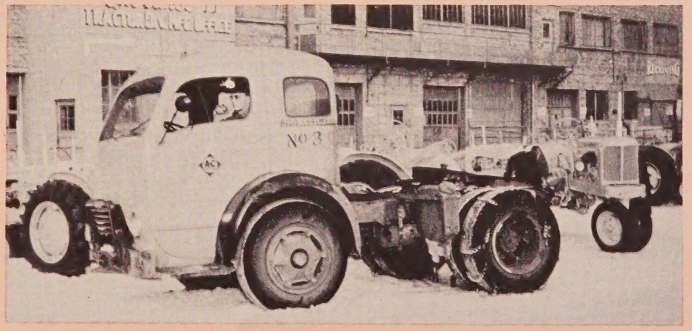
Way at Allis-Chalmers....

Water tower on which is mounted the base station antenna. This is the highest point on the Allis-Chalmer grounds.

The driver of a 3-ton truck takes a call from the dispatcher in the Motor Transportation dispatching center.

Martin Franke, Motorola Service Station operator, at the main station transmitter-receiver in the heating shed below the plant water tower.

This railroad crane is directed by Motorola 2-way radio in its movements. As a result is can be moved from job to job about the plant area without the operator ever having to leave the cab to use a telephone, or having to send a messenger out to the unit with instructions.



One of the two Motorola radio-equipped tractor-trucks used with eight trailers in the plant area.

INDUSTRIAL RADIO

THREE YEARS OF PHENOMENAL GROWTH

WHO USES IT
HOW IT'S USED
HOW TO GET IT

Industrial straddle truck in Timken Roller Bearing yards is equipped with 2-way radio for efficiency of movement and better control.

When experimental vehicular communications radio licenses were issued by the old Federal Radio Commission in the late 1920's, few, in public or private life, visualized the important part which vehicular radio communications would eventually play in our everyday living.

Today 2-way radios are being used extensively in aviation, marine, public safety, disaster, land transportation, public and industrial services, as well as for experimental and amateur services.

One of the most recently developed usages, which has displayed phenomenal growth, is the industrial application. Although the Federal Communications Commission set up frequency allocations for this service only three years ago, radio systems have already mushroomed in more than 750 operating plants.

MAJOR INSTALLATIONS

Throughout the past year the Motorola Newsgram has discussed and described such major installations as those at the Johnson and Johnson warehouse in Metuchen, New Jersey, the Eastman Kodak plant in Rochester, New York; the Timken Roller Bearing plant in Canton, Ohio and many other systems including the Thompson Products, Cleveland, Ohio installation and the Allis-Chalmers system in Milwaukee which are described in this special industrial issue.

From the Kaiser Steel Corporation plant in Fantana, California to the American Bridge Company in Wilmington, Delaware; from the Kellogg Company in Battle Creek, Michigan to Merritt-Chapman & Scott Corporation in St. Louis, Mississippi, industries are adopting Motorola 2-way industrial radio. These world-known companies, as well as hundreds of others of all sizes, want 2-way radio and they want the best.

SURVEY RESULTS

A survey made several months ago obtained answers to two important questions relative to industrial radio:

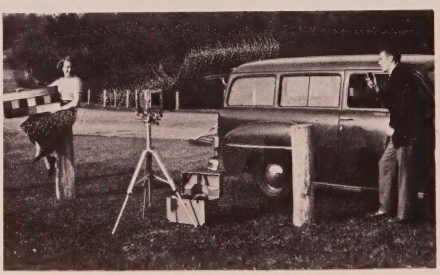
1. What types of materials handling equipment lend themselves to mobile communications?

Most persons answered that anything that moves such as switch engines, locomotive cranes, industrial trucks, straddle trucks, overhead cranes in bay areas, inter-plant tractors and trailers, elevators, personnel carriers, passenger cars used on plant grounds, and other units, would lend themselves well to radio control.

2. What types of equipment by virtue of their initial first cost, high cost for "down-time", and other relative factors, appear to make 2-way radio a worthwhile investment?

THE ANSWER

The answer in general was that in the average industrial plant, the obsolescence cost of material handling equipment averages between $4.00 and $8.00 per day, depending on the initial expenditure. The servicing and maintenance cost, plus the personnel to operate the equipment averages between $12.00 and $20.00 per day. Thus, it can be seen



Color Test Crew at the Eastman Kodak plant. Motorola 2-way radio in the station wagon serves double duty. Crew uses it in the daytime when on location some distance from the plant to keep in touch with its testing laboratory. It is used at night by Kodak Park plant protection personnel.

With a central dispatching center for materials handling equipment, a company can more evenly distribute the handling load, as well as cut waiting and deadheading time.

that these day-in-day-out operating costs are much higher than obsolescence or depreciation costs.

EFFICIENCY INCREASE

If, by any means, the productive efficiency of this equipment can be increased and the operating cost lowered, substantial savings can be realized.

Productive efficiency can be increased through (1) better servicing and maintenance programs, (2) more efficient scheduling, and (3) more expendient delivery and pickup of materials.

The use of 2-way radio makes possible all of these advantages.

Almost every type of plant vehicle from yard locomotive to the smallest personnel carrier can be equipped with 2-way radio with resulting dollar and cents savings.

FM 2-way radio used by industry can actually be justified in dollars and cents.

"Radio control is the most important materials handling concept since the unit load principle," says James Bright, editor of Modern Materials Handling magazine.

PLANT PROTECTION

Today, industrial Plant Protection officials and materials handling supervisors are grasping the opportunity of also incorporating the everyday materials handling workhorse, mobile radio communications, into civil defense preparations.

The radio system can be used not only to increase general materials handling efficiency during normal production activities, but also is organized to become a plant protection and civil defense tool in case of air attack, shelling, sabotage or other wartime emergency. Here are four major factors in using 2-way radio for both activities:

1. Plant protection and civil defense equipment such as fire, ambulance, and police vehicles are within instant communications at all times with 2-way radio, and point-to-point communications service is assured in case telephone lines go out.

2. Emergency repair equipment can be moved from place to place rapidly in order to restore production in case of breakdown when directed by 2-way radio.

3. By day-in-day-out use, management can be sure the radio equipment is always in operating condition in case of an emergency.

4. Only by continuous usage can individuals be trained sufficiently to assure their being able to operate the communications equipment under emergency conditions.

LICENSING PROCEDURE

In setting up licensing for industrial radio use in July, 1949, the FCC outlined two different radio services that are available. One is the Low-Power Industrial Radio Service, and the other is the Special Industrial Radio Service.

The Low - Power Industrial Radio Service is available to any person or firm that is "engaged in a commercial activity or industrial enterprise."

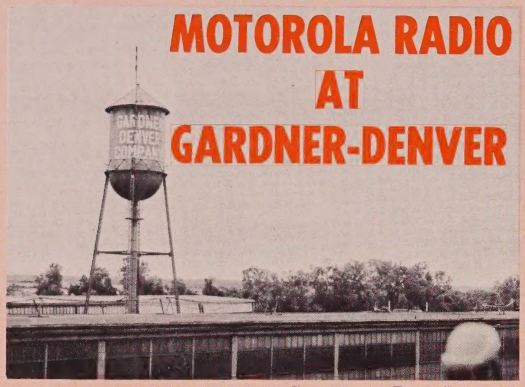
Reliable communications range within this category is approximately one-half to one mile. This type of system is particularly well adapted to control of trucks and other mobile equipments within large plants or closely adjacent yard areas.

SPECIAL LICENSE

If greater range is required, it is possible in many cases to obtain licensing under the Special Industrial Radio Service. Higher power is permissible under this category and ranges from 10 to 50 miles can be obtained, depending on the power, antenna height, terrain and frequencies used.

In all cases, Motorola engineers will handle the details of obtaining license for station operation. The purchaser of the equipment need have no fear of becoming embroiled in red tape, but by merely answering a few questions can generally be sure of obtaining full licensing in 30 to 60 days after applications.

MOTOROLA RADIO AT GARDNER-DENVER



A phone call to the Main Guard House at the Gardner-Denver Company in Quincy, Ill. for a truck or a fork-lift brings immediate effortless service.

The company, manufacturer of heavy compressors for industrial use and air operated rock drills for use in mining and highway work, has equipped six fork-lifts, two stake trucks and a ¾ ton pickup with Motorola Uni-Channel Sensicon Dispatchers.

The guard on duty in the Main Guard House handles all the calls and acts as the general central dispatcher.

By this method, Gardner-Denver is able to convert guard-man hours which are normally only on standby, into efficient productivity. The radio system, as well as the personnel, are used day-in, day-out as industrial production aides, while doubling in brass as an ever ready emergency plant protection facility.

The radio-controlled highway trucks are used for hauling materials between the Quincy, Illinois plant and the LaGrange, Mo. foundry which are about 10 miles apart. The fork-lifts are dispatched within the plant area in the materials handling operations.

The suggestion to install 2-way radio originated in a weekly meeting held by all maintenance foremen and was made by Carl Hiland, foreman of plant Maintenance, at one of the company's plants.

1

1. Roy Smyser of Gardner — Denver makes a call to the central dispatcher for instructions.

2

2. In the plant guard house, George Wiskerchen presses the push-to-talk button to call a vehicle for an assignment.

3

3. Charles Goodwin, Jim Walton and Karl Entsminger at their 2-way radio - equipped trucks.

4

4. At the Gardner-Denver Company, Alton McClune, Roy Smyser, Bert Johnson, Eugene Kelle, Bob Lefringhouse, and Dan Terrell line up to display their Motorola-radio equipped fork-lift trucks.

THOMPSON'S PLAN TRIPLES TRUCK OUTPUT

Dispatcher directs orders to personnel carrier and fork-lift operators seen through the window, as well as 31 other plant vehicles.

Here is how one company boosted running time from a low of 20% to more than 90% of scheduled time

There is no substitute for a system of instant communications which reaches all members of a centralized materials handling group at the same time. This is the conclusion of W. V. H. Moore, foreman of Materials Handling at the TAPCO Plant of Thompson Products, Inc. of Cleveland.

Moore reached this conclusion after he spent five years centralizing the materials handling control and installing two-way radios.

"When every department in a plant operates its own material handling trucks, in the absence of a centralized material handling department, idle machine hours are an inevitable result", Moore insists.

CENTRALIZATION

In 1946 Service Recorders were installed on all the trucks, and it was found that the trucks were operating 20 to 50 per cent of the time. During the next five years all the materials handling responsibilities were transferred from 12 separate departments to one centralized group. Running time increased to 92% average.

Various means of contacting operators were used. First, a supervisor attempted to contact each truck operator personally. This resulted in long delays.

A flasher system was tried by placing red signal lights at strategic points about the plant with the hope that a driver of an empty truck would eventually come along, see them, stop, and call in for further orders.

With the flasher system, it took as much as 20 or 30 minutes to call trucks together to help out on an emergency job.

MOTOROLA RADIOS

The first twelve mobile radios were purchased from Motorola in March, 1950. At that time, about 35 requests for trucks per 8-hour day were being handled by the flasher system.

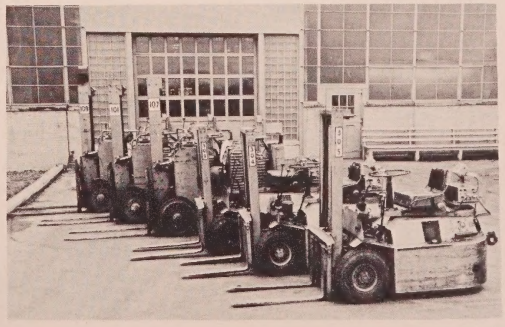
Thirty days after the radios were installed, the requests had increased to 95 per 8-hour day. Today, with 33 trucks equipped with radios, the requests for trucks have increased to 460 during the same period. All these calls are handled by one dispatcher.

RADIO ADVANTAGES

All drivers can hear all communications. Many times a driver other than the one called is closer to the job and will speak up to say he can take care of the load.

Or, there is a need for more than one truck to move a load. In such cases, too, truck operators will call in to say that they are able to help out.

As a result of the improvements achieved, Motorola 2-way radios paid for themselves in less than 6 months, Moore said.



A line-up of fork-lift trucks at the TAPCO plant of Thompson's gives an indication of the type of Motorola radio - equipped vehicles the company is using.

RADIO CONTROLLED CURB SERVICE

"Handie-Talkie" Portables at Milwaukee Drive-In

Two girl car-hops in Milwaukee are doing the work five girls performed previously.

And by making efficient use of Motorola "Handie-Talkie" radiophones, the Ace Foods, Inc. drive-in now serves approximately 30 per cent more customers nightly between 5:00 p. m. and midnight. A total of 950 customers receive extremely rapid and courteous treatment by two order-takers and three delivery girls. A total of eight girls were required previously. Here's how the system works:

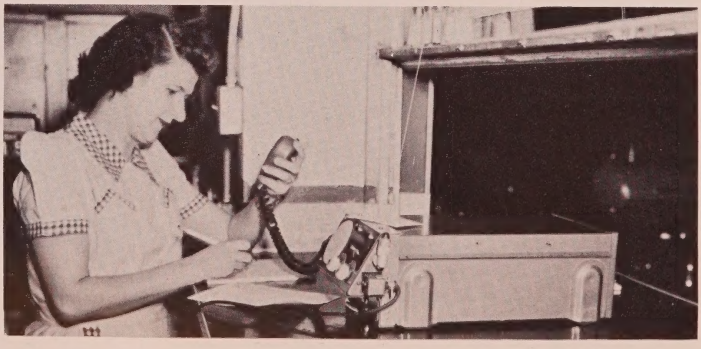
A carload of appetites drives up. An attractive young lady car-hop with a Motorola portable hands the driver a special menu. The car-hop writes the order on a special order blank, gives the customer a copy and then broadcasts the order to the girl dispatcher in the firm's kitchen. She then places a key car number on the customer's windshield, corresponding to the order number broadcast.

In the kitchen the dispatcher records the order, prices and car number. The order is filled and one of three delivery girls takes it to the designated car and presents the slip for payment.

The car-hops meanwhile continue making the rounds of the 136 car lot taking orders. Customers continue to be pleased by the fast, efficient service they receive.

Above: A girl car-hop takes an order which she will immediately call in to the dispatcher in the kitchen.

Below: The dispatcher records order just received from a girl in the parking area.



PHYSICIANS' RADIO MODERN MEDICAL AIDE

Above: Dr. James Louisell checks with his home office over his Motorola front-mount version Uni-Channel Sensicon Dispatcher.

Right: Mrs. Lucille Louisell, wife of Bridgman's only practicing physician, dispatching her husband to an emergency call.

Motorola in Car and Residence for Faster Professional Service

The life of the rural doctor has been repeatedly depicted in story and frame. Pushing through snow drifts, blizzards and rain storms, day or night, he covers large expanses of sparsely inhabited land that is tied together by a minimum of communications lines.

Life and death often hang in the balance while he disrupts a restful fireside dinner at home to speed to an ailing patient after an emergency telephone call. Sometimes a doctor may return to his home only to find that he is required back near the point from which he just came. And often the time he has taken to drive the many miles home, plus that of the return trip, could be sufficient to make the difference between life and death.

ADVANTAGES

With 2-way radio equipment in his car, a physician can go directly from one call to another as a result of directions from his dispatching center.

An example of such an installation is that belonging to Dr. James Louisell, the only practicing physician in Berrien County, Mich., an area of about 1,000 inhabitants.

The South Bend, Indiana Tribune has reported that one day a few weeks ago the doctor's telephone rang and a frantic young farm wife whispered "Please send the doctor right away. My baby's turning blue!"

Minutes later, Dr. Louisell was attending the choking, gasping week-old infant.

DOCTOR NEARBY

The physician had been on his way to Bridgman, Mich., his home, after a routine hospital call in St. Joseph, 12 miles away, when his wife, Lucille, communicated the emergency message over their Motorola 2-way, house-to-car, radio system.

"Were it not for the radio, I would not have received the message until I had reached home," he said. "It could have been too late. You never know."

After only a few months of using the radio equipment, Dr. Louisell is satisfied that the system is worth every penny that it cost. "The ease of mind, knowing that I can be reached when I'm needed, is worth a lot," he said.

RADIO NEEDED

Because of the large area this doctor covers, the radio is particularly well adapted to his practice.

The job of "dispatcher" fell to Mrs. Louisell. The Uni-Channel Sensicon Dispatcher base station is installed in the kitchen where she, as homemaker and mother of four children, spends much of her time.

"I can hear it from any part of the house when the doctor calls," she explained.

Dr. Louisell, who served in the Philippine Islands and on Okinawa as an army doctor, reported that it is difficult to say whether it has actually saved lives yet. "But I have no doubt that it will if it hasn't already," he said.

ON-THE-SPOT AIR CRASH COVERAGE!

Denver Radio Station News Director Equips His Car With Motorola Radio

Top: Dick Leonard displays his Motorola radio equipment by which he gives on-the-spot news reports to Denver listeners.

In December, a B-29 crashed in the Hilltop residential section of Denver. Most of the city's radio stations had reporters on the scene within minutes. In all cases, except one, reports were telephoned to the studios and recorded, or were tape recorded on the spot and carried to the station.

In one case—that of Dick Leonard, news director of WMYR—the story of the crash scene was described directly to the radio audience. Leonard, as pictured above, broadcast his on-the-spot report through the Motorola 2-way mobile radio in his car.

Glen James KMYR's Chief Engineer, and Leonard decided long ago that the radio station needed a radio-equipped car.

Finally, they purchased a pair of Motorola mobile 2-way radios and converted one set to A.C. for installation in KMYR offices as a base station. The other unit was installed in Leonard's car.

The system is engineered so that signals from the transmitter in Leonard's car are piped into either the broadcast console, into a recorder at the studio, or into the news room for rewrite.

Among other major coverages during the first few weeks of the installation besides the B-29 crash, were a large fire just outside Denver, a grand jury session, a human-relations Christmas story, and many other more minor items.

"The first use more than paid for the cost of investment," Leonard reported. "I can't sing the praises too high!"

PRIVATE PLANES SPEED REPAIRS BY 2-WAY RADIOS

Kans.-Neb. Gas Co. Adds Motorola Communications

When a call comes into the Hastings, Nebraska office of the Kansas-Nebraska Natural Gas Company, Inc. reporting a break along the pipelines, Motorola 2-way radio is put into action immediately.

One day, while the thermometers read —10°F and most of Nebraska's side roads were blocked with snow, Leonard Condit, pilot and mechanical engineer for the company received notice of a break near Campbell, Nebr. approximately 45 miles away.

In 30 minutes he was flying in a Motorola radio-equipped plane and directing the field crews over open roads by radio to the break.

"We feel certain that at least 2 hours were saved by knowing the exact location of the break and being able to direct the repair crews to it with the least amount of delay," Condit reported.

"It is possible that the towns of Hastings or Grand Island might have been lost in that time. When that happens it means thousands of dollars in expense and a great inconvenience to customers in such cold weather."

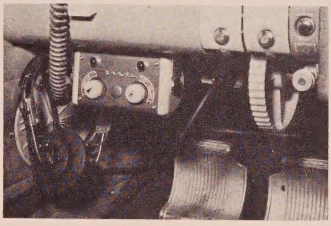
The company, which supplies natural gas to 143 cities and towns in 48 Nebraska and Kansas counties, has installed Motorola Uni-Channels in two of its planes, a Cessna and a Bonanza.

By radio the pilots often receive orders from management to change course to land and pick up passengers or parts. This has saved many hours of flying time and lowered the cost of aircraft operation, Condit reported.

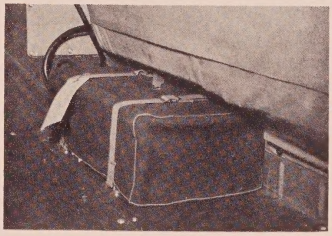
Members of a Kans.-Neb. Gas Company repair crew, rushed to a break in the line with the aid of radio-equipped planes, begin the job of putting the line back into operation.

SYSTEM INSTALLATIONS

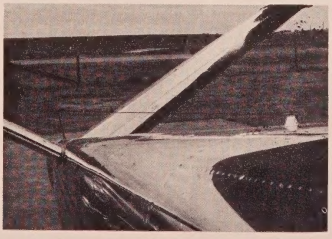
In the Bonanza . . .



Control head installation in the Bonanza showing earphones.

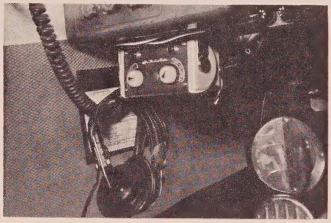


Uni-Channel installation in the forward side of the baggage compartment of the Beach Bonanza.

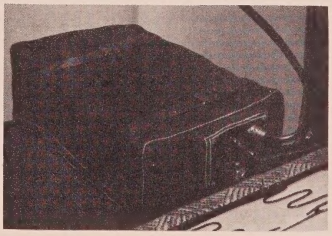


Antenna installation on the Bonanza for Motorola radio system.

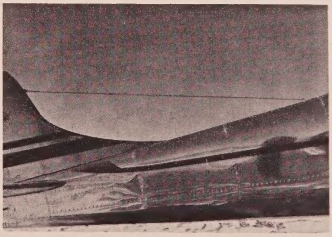
In the Cessna . . .



In the Cessna is seen the control head and earphone installation.



Motorola radio mounted on the left hand side of the baggage compartment of the Cessna "170".



Cessna "170" antenna mounting for 2-way radio operation.

RICHMOND, FREDERICKSBURG & POTOMAC INSTALLS MOTOROLA RAILROAD RADIO

Over a 110-mile stretch of track between Richmond, Virginia and Washington, D. C. tranverses the Richmond, Fredericksburg, and Potomac Railroad's mile-long freights and speeding passenger trains.

To maintain the necessary pace, as well as highest safety requirements, demands extremely rigid and continuing control over all train movements.

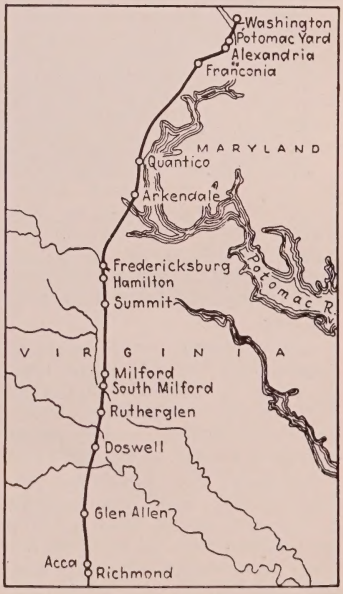
The R. F. & P. has selected a complete system of Motorola FM Universal Railroad Radio as its communications facilities for achieving these essentials.

The radio system provides for communications on two channels, Channel No. 1 at 161.55 Mc and Channel No. 2 at 161.67 Mc. All trains and other mobile units receive only on Channel No. 1, but can transmit on either of the two channels.

Five main-line wayside 2-way radio stations, each connected by telephone line to the dispatcher's office in Richmond, are located at high points along the right of way. Each wayside station, incorporating standard Motorola Universal railroad equipment, is housed in a 6-ft. by 6-ft. by 8-ft. steel building with its antenna mounted above on an 80-ft. pole. Each station transmits on Channel No. 1 and receives on Channel No. 2.

This organization of frequency usage makes it possible to permit radio communications between mobile units, train-to-train and end-to-end on Channel No. 1 without interfering with operations of the train dispatcher in Richmond.

Portable "Handie-Talkie" radiophones are used in the cabooses. Each caboose has a permanent antenna mounted on its roof, and a rack for holding the portable is installed inside. The radiophone is placed in the caboose at Richmond before the train leaves, and connected to the outside antenna. When the caboose returns to Richmond after making a round trip to the Potomac Yard in Alex-



Map of the railroad system.

andria, the "Handie-Talkie" portable is taken from the caboose, the storage batteries removed, and fully charged storage batteries are installed.

Using a "Handie-Talkie" portable in the caboose of each train makes this radio set always available for use as a hand carried unit should the need arise.

The dispatcher in Richmond has facilities for disconnecting all wayside receivers except the one nearest the train to which he is talking. This circuit is so arranged that all receivers automatically are returned to operation in approximately 20 seconds after the dispatcher's foot switch is last operated.

Local controls are installed at each of the wayside stations to provide testing equipment for checking and servicing facilities.

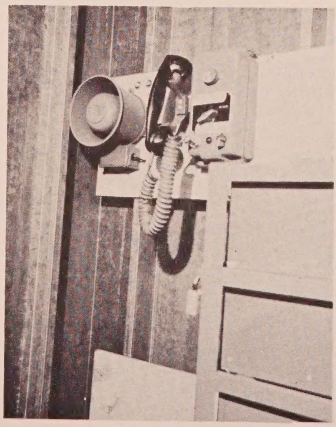
Additional wayside stations using A.C. operated, 10-watt Uni-Channel Sensicon Dispatchers are installed at Acca Yard in Richmond and Potomac Yard, near Alexandria. These units receive and transmit only on Channel No. 1 and are used by the yardmaster to instruct arriving freight trains regarding the disposition of their trains.

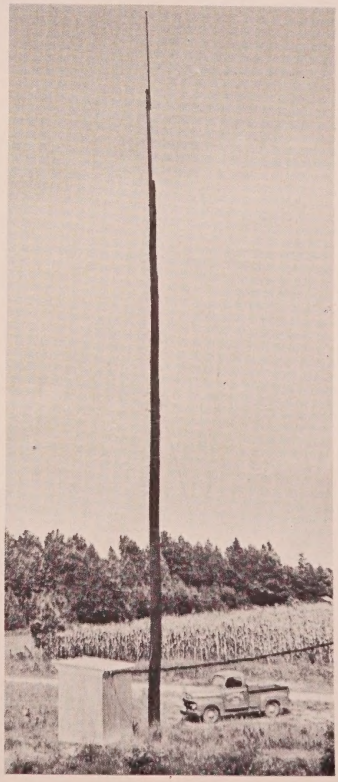
Top left: In each of the cabooses is installed a Motorola "Handie-Talkie" portable radiophone which connects to an antenna mounted on the roof.

Top right: In a R.F.&P. locomotive cab, the engineman is within easy reach of the Motorola Universal railroad equipment handset.

Right: One of the five unattended wayside stations along the route between Richmond and Washington.

Below: Motorola terminal equipment used for testing in an unattended wayside station.





Motorola...

in the great

How Business Men And Law Enforcement Agencies Of The Southwest Are Taking Advantage Of Radio Communications.

Above: Although law enforcement agencies long have had 2-way radio it was only the development of the "Handie-Talkie" portable that made it possible for possemen on horseback to use this type of communications. Here Jim Van Winkle, captain of the hounds, for the Arizona State Prison, calls for additional men to pick up the trail of an escaper.

Right: The operator of an Isbell Construction Company Motorola radio-equipped truck checks with headquarters from the edge of a strip mining operation. It is radio equipment such as this that the people of Arizona are accepting as a necessity to every day activities.

Below: Ernie Chilson of the Bar-T-Bar ranch uses a Motorola portable while riding the range. He can contact the main ranch house at any time and efficiently supervise operations on the mammoth Northern Arizona cattle spread by the use of instant communications.

Ore from the pit is dumped from a truck into a bin at the main headquarters while a company employee radios a report to the central dispatching center over his frontmount Motorola Uni-Channel Sensicon Dispatcher.

Southwest

Inhabitants of colorful Arizona are accepting Motorola 2-way radios as the efficient communications method for overcoming the wide expanses, and the means of increasing day-in-day-out production. By ranchers, farmers, logging firms; by police officials, mining organizations, REA's, these radio units are being adopted by increasing numbers. On these pages are picture-stories of typical installations. They demonstrate the wide use being made of the equipment throughout the state.

(Pictures courtesy of the Arizona Republic.)

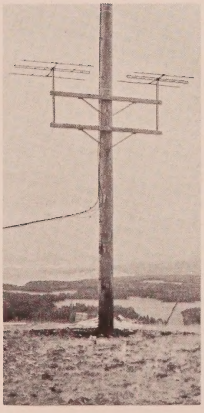
Above: Bob Anderson of the Anderson Brothers farms in Casa Grande talks to men in charge of irrigation on his property. When they have enough water for a cotton field, a quick call by radio enables him to turn off the pumps quickly.

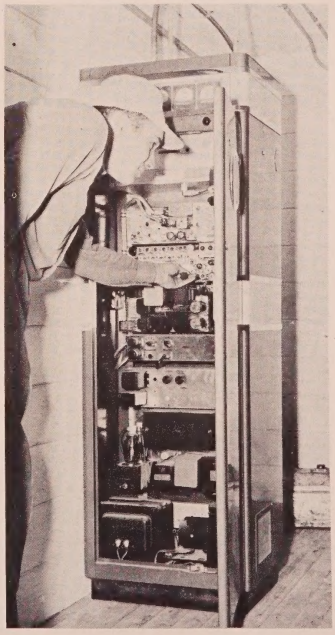
Above: Mrs. Maude Anderson, operates the Motorola locally controlled central station in her home in order to keep in touch with men on the 5,000 acres of cotton farms at Casa Grande and Stanford.

Left: These antennas 10,000 feet high on Green Mountain between McNary and Springerville are used for 2-way radio operations by the Southwest Lumber Co. and the Lakeside REA Cooperative.

Below: Ernest E. Fraze of Eloy, of the Arizona Edison Co. reports by 2-way radio to his main office on the progress of a new line to a drive-in theater. In Arizona, as well, Motorola communications is a must for public utilities.

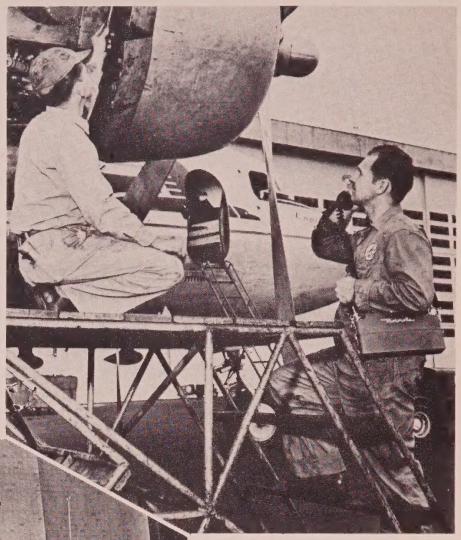
Right: Ermon Lewis, radio technician at McNary, checks Motorola equipment belonging to the Lakeside REA, one of the Northern Arizona installations.

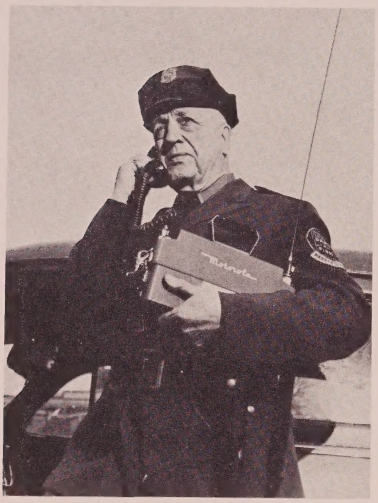




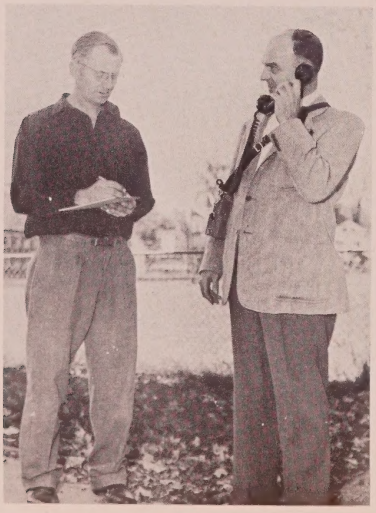
MOTOROLA, EVERYWHERE

Airlines have found Motorola radio equipment valuable as an aid in preparation for flight, as well as for relaying messages for planes already in the sky. Picture-stories on these two pages describe these uses. Here, also, are descriptive illustrations of Motorola radios in use by civil defense officials, surveyers, municipalities, and other vital, continuing operations. These persons and organizations have found from experience that 2-way radio provides improved and more efficient operations. See how these systems operate!





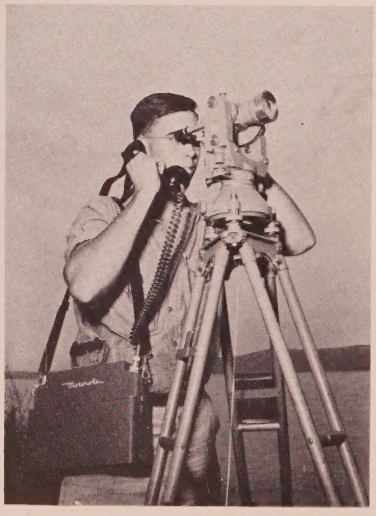
Passengers on Capitol Airlines out of Washington, D. C. now are continuously informed of their flight status by "Handie-Talkie" portables. Above is a mechanic relaying information to the flight dispatch office, left, in which is installed a Uni-Channel Sensicon Dispatcher. (Photos courtesy Aviation Week).



Above, left: Warden A. G. Boysen of St. Paul, Minn., with one of the 15 new Motorola "Handie-Talkie" portable radiophones placed in operation recently by the Warden Service, Division of Game and Fish, Minnesota Department of Conservation.

Left: Town of North Berwick, Maine, Civil Defense Officials, Philip Dutch, left and Ralph Cressey use one of their new "Handie-Talkie" portable radiophones.

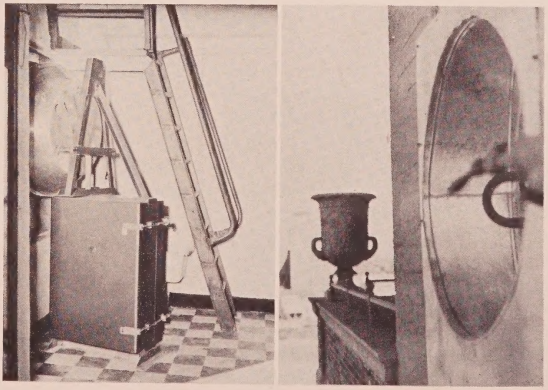
Right: Consulting Engineers, Madigan Hyland, used "Handie-Talkie" portables in making a bridge survey across the Hudson River for the N. Y. State Thruway.



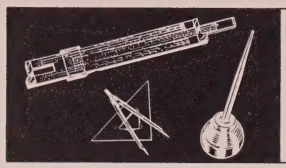
Left: These five men are mounting a passive reflector on a Waianae mountain station tower in Hawaii for the Motorola Microwave relay system recently installed for the Hawaiian Airlines.

Above: St. Paul, Minn. water department recently completed installation of a Motorola 2-way system for communications between central offices and eight vehicles. Here is Joseph Fritz, the dispatcher seated; Water Commissioner Severin Mortinson, left; and Leonard Thompson, water department general manager.

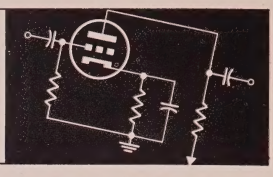
Chief Reed Shoulders operates the Motorola base station owned by the City of Franklin, Kentucky. This system, operating on 39.5 Mc monitors the state police while the state police, operating on 44.62, monitor it.

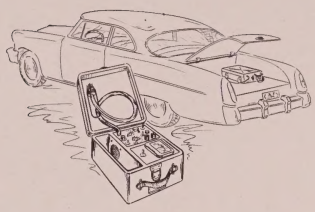


Unique wall installation of Motorola's MCC operation in Phoenix, Arizona. Above left, is shown the R.F. equipment inside the Security Building. Above, right; the microwave system parabolic antenna is mounted flush with the wall. Signals are transmitted to and from White Tank Mountain for extended VHF coverage.



Technical Notes Section





PREVENTIVE MAINTENANCE

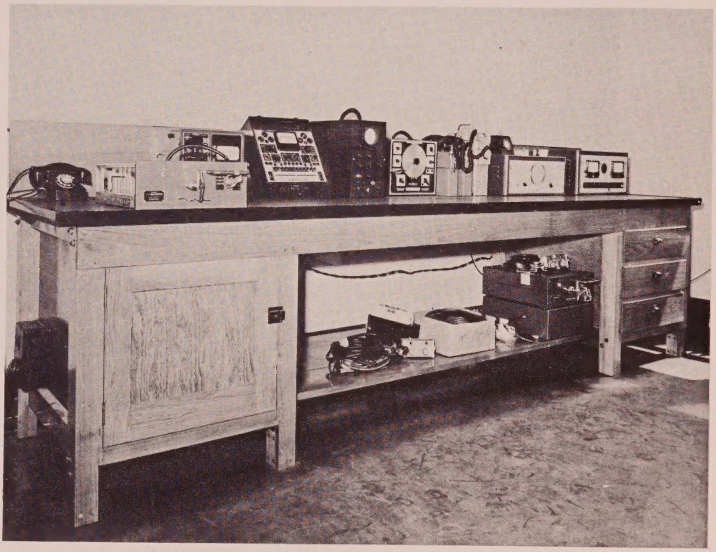
for

FM 2-Way Radio Equipment

Preventive maintenance, the practice of anticipating and correcting troubles before they occur, is a practical method of keeping radio outage time low and minimizing repair expenses. Radio equipped vehicles not only pay for the radio equipment in increased efficiency of operation but also may even pay for the vehicles themselves. Similarly a comprehensive preventive maintenance program, when properly undertaken, will also pay for itself. This is particularly true in the case of income producing vehicles such as taxicabs where outages can mean loss of business plus the loss of time spent in repairs.

SERVICING

In larger radio systems it is both economical and practicable to establish a complete service and repair shop which is capable of handling the preventive maintenance as well as all major repairs. A limiting factor is the services of a full-time, competent and experienced radio technician. Many smaller companies have found they can obtain satisfactory contracts with radio service stations for equipment maintenance on a fixed fee basis. Other owners find that combining the two programs, maintaining a shop for minor repair and simple testing, while contracting with a service station for major maintenance, keeps expenses at a minimum.



Spaciousness and good working conditions make this shop ideal for radio repair work.

SHOP FACILITIES

Certain fundamental resources are necessary to maintain a shop, small or large. Included among these requirements are work benches, record files, tube storage cases, small parts cabinets and spare radio equipment shelves. The sizes and arrangements of these facilities are, of course, dependent on the size of the shop and the number of units to be serviced.

The shop itself should be adequately heated, lighted and ventilated and separated from other garage or service facilities. Calibration, adjustment and repair of electronic equipment requires concentration and freedom from distractions. High voltage hazards, delicate instruments and valuable stock are additional reasons for exclusion of unauthorized personnel. Because service work on mobile units must be carried

on regardless of weather conditions, it is good practice to design the shop to include drive-in accommodations.

TEST EQUIPMENT

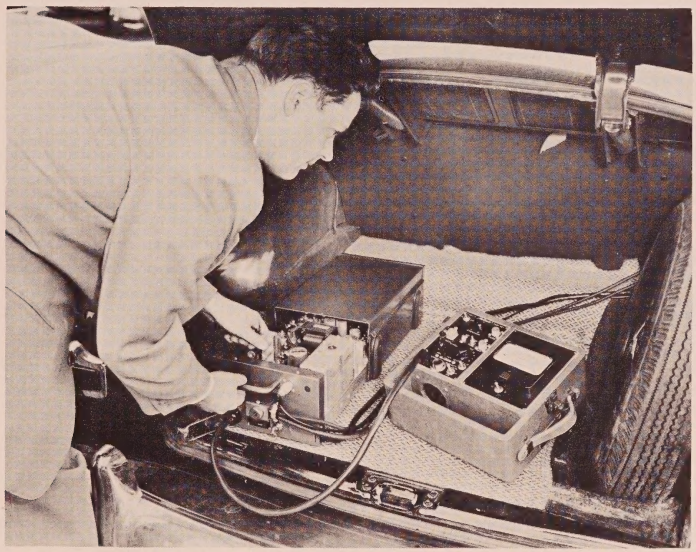
Of all the equipment in a 2-way radio shop, the volt-ohm-milliameter and the signal generator are considered the most important. Since these are the basic items, they should be of the highest quality. The smallest shops often also use:

A frequency monitor and deviation meter

A tube tester and analyzer

An audio output meter

A vibrator tester



Periodic checks keep mobile units operating at peak efficiency.

A vacuum tube voltmeter

A RF wattmeter

An adequate storage battery and charger

A complete set of small shop tools

Often a single instrument may serve the purpose of two or more of the above.

Large shops, of course, should be more completely equipped and may contain, a oscilloscope, a communications receiver, a field strength meter, a capacity bridge, a variable voltage B+ supply and DC primary power supplies of several voltages.

ROUTINE MAINTENANCE

Suggested monthly tests of the mobile units include:

1. Listening test;

An experienced technician can often discern warnings of impending trouble by noting the audio quality, the sensitivity, and the volume and squelch control settings.

2. Measurements;

Check the transmitter and receiver "A" and "B" voltages and all transmitter tuning adjustments.

3. Visual Inspection;

Check all wiring, screws, bolts, microphone cord, relay contacts and battery terminal and fuse connections.

Semi-anually, a more thorough mobile unit inspection should include:

1. Frequency checks

2. Cleaning with a low pressure air blast and brush

3. Touch-up alignment of both transmitter and receiver

4. Tests of the power supplies

5. Dynamotor lubrication and brush replacement if required

6. Cleaning of all relay contacts

Base stations should be checked more often than mobile units and require the following additional attentions:

1. Check and clean the remote control relay contacts

2. Check the ventilating and temperature control devices

3. Measure the "B" voltage, db. readings on the remote control console and check the mike quality, condition of the controls and setting of the volume levels.

4. Lubricate the blower motors if required.

OTHER CONSIDERATIONS

Tubes should only be exchanged as necessary. Tube testers are generally unreliable for checking IF and RF tubes. Tubes that appear "good" on the checker may not operate satisfactorily at high frequencies and conversely, a tube that tests "poor" may continue to provide many months of dependable service under actual operating conditions. Stage sensitivity measurements are a much better indication of tube weakness. New tubes should be watched carefully for the first few hours of operation to see that they are functioning normally. Once past this crucial period, they will usually operate for several thousand hours with only routine attention.

It is wise to utilize service record cards for each unit. Problems of a common nature are more easily detected and the technician is better enabled to provide the most satisfactory service.

It is imperative that the preventive maintenance program be followed consistently and continuously. Skipping a few checkups is the same as not following a program at all. It has been proved again and again that healthy cuts in the upkeep cost of mobile radio operation may be achieved by maintaining equipment in peak operating condition. The results differ in each case but whether costs are cut 5% or 25%, the radio operator will find the program worthwhile.

"There is no progress without change"

EQUIPMENT MODIFICATIONS

For improved performance...
extended life...
economical maintenance...

2E26 TRANSMITTER TUBES

Originally, type 2E26 transmitting tubes were designed with grid emission to achieve maximum power output with minimum drive. Redesign, eliminating grid emission, compensated for lack of uniformity in manufacture. However, an oversight by the manufacturer allowed both types of tubes to appear on the market.

Current models of the Uni-Channel 10/12 w. transmitter are designed to utilize either version of the tube with equal results. If low power output or difficulty in driving is experienced with early Uni-Channel transmitters, tube variations can be obviated by resistance changes.

1. 25-50 mc. 12 w. models, P-9030 and P-9050 series:
Change the PA grid resistor, R-123 from 27,000 ohms to 12,000 ohms.

2. 152-174 mc. 10 w. models, P-9020 and P-9040 series:
Change the PA grid resistor, R-121 from 33,000 ohms to 12,000 ohms and change the doubler-driver screen dropping resistor, R-120, from 39,000 ohms to 82,000 ohms.

PILOT BULBS

Control head pilot bulbs for use in 12 volt mobile systems, especially those subjected to severe vibration or shock, are susceptible to filament breakage unless the proper bulb is used. The greater mass of the 12 volt filament requires better support than commonly found in 6 volt bulbs. All current shipments requiring 12 volt bulbs include Type #1815 bulbs (Motorola Part No. 65A84419) which have an additional center leg filament support. Whenever replacements are made, use only bulbs with the three leg filament support.

LOW POWER INDUSTRIAL

Low Power Industrial equipment (FMT-22 and FMTU-22 series models) was originally shipped with jumper connections between terminals 6, 11 and 15 on the transmitter terminal board in the P-9027-A-LP, P-9027-C-LP or P-9031-A-LP power supply chassis. Improved operation through greater B+ filtering is obtained by changing these jumper connections. It is recommended that the lead connected to terminal 15 be disconnected and reconnected to terminal 7. Terminals 6, 7 and 11 are then jumpered together.

SQUELCH MODIFICATIONS

A minor modification to the Sensicon Receiver, already incorporated in current production models, will provide a greater effective range of the receiver squelch control. This modification is easily accomplished on older model receivers with readily available components.

The resistance in the capacitor-resistor assembly, E-301, is reduced to 15,000 ohms. This may be done either by inserting a replacement part, 21A813318, which includes a 15,000 ohm resistor or by placing a 22,000 ohm, ½ watt resistor, part no. 6R6397, in parallel with the present resistance in the assembly. It is also necessary to replace coupling capacitor C-365, 100 mmf., with 21R-2748, mica, 200 mmf., ±10%, 500 vdcw.

With both of these changes incorporated, the noise frequency response of the noise amplifier is changed to provide a higher noise voltage level. This results in a greater effectiveness of the squelch control by increasing the range of rotation.

MOTORCYCLE CONTROLS

In the original Uni-Channel motorcycle radio equipment, the control units (P-8535-C, Servi-Car and P-8506-E, Solocycle) utilized three 10 ohm resistors as the volume control pad. With a slight modification, improved audio output characteristics are realized at a lower setting of the receiver chassis volume control. It is suggested that the 10 ohm resistor connected to the speaker be changed to 2.7 ohms ±5%, ½ w. (Part No. 17K892226) and the center resistor be changed to 8.2 ohms ±5%, ½ w. (Part No. 17K892227). Fig. 1 is a partial diagram of the revised circuit.

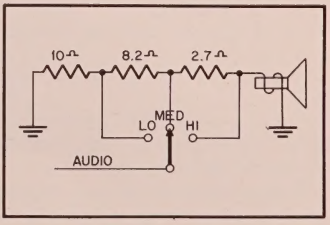


Fig. 1, A partial diagram showing revisions to motorcycle control units.

SYSTEM EXPANSION

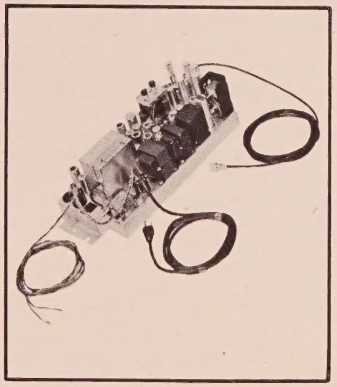
ADDING ADDITIONAL RECEIVING FACILITIES

- **for monitoring other channels**
- **for multi-frequency operation**
- **for emergency communications networks**

In the normal course of system operation, it is often necessary to add additional facilities to the existing system to increase coverage, add emergency features or expand the overall system. When adding these additional receivers, there are several patterns that may be followed.

1. A second operating frequency may be added to the existing receiver (not recommended for field conversion).
2. A separate table-top receiver may be utilized.
3. A separate rack mounted receiver may be installed.
4. An integral second receiver may be added.

Each of these solutions has specific applications and limitations which must be considered before arriving at the final decision.



The PA-9147 rack mounted auxiliary base station receiver is used in place of a table-top receiver when adequate rack mounting space is available. Versions of this Sensicon Receiver are available for 25-50 mc. and 152-174 mc. operation.

TABLE TOP RECEIVERS

Locally controlled table top, 117 VAC operated receivers are available in both the Sensicon and Uni-Channel models for either 25–50 mc. or 152–174 mc. operation. These units are supplied complete with power supply, speaker and control panel mounted in an attractive cabinet and are ideal as channel monitoring receivers. Any standard 50 ohm antenna and transmission line may be used with these receivers.

RACK RECEIVERS

Any of the various standard antennas are suitable for use with this receiver. Models are available with either the standard Permakay 15 coil filter or with a two coil tunable filter.

SECOND RECEIVERS

A #2 receiver may be added to the existing base station if the associated chassis are also exchanged. A power supply for the #2 receiver must be added. The single-receiver remote control chassis and the power and control cables must be replaced with the two-receiver versions, and if not already so equipped, the remote control console must be modified for two-receiver operation. If desired, the effective loss of sensitivity through signal division between the receivers may be countered with one of the Motorola Antenna Coupler Chassis, a broad-band RF amplifier. However, the antenna cable kit for two-receiver models contains tuned lines to minimize this loss. If the frequencies of the receivers are separated by less than 500 kc., it may be necessary to employ a unique method of establishing IF and crystal frequencies to avoid mutual receiver interference.

I.F. FREQUENCIES

In any multiple receiver base station, when the received frequencies are separated by less than 500 kc. and the receivers use a common antenna, the #1 receiver uses standard crystal formulas but the #2 receiver uses modified formulas.

When F_2 is higher than F_1:

$F_{x2} = F_{x1}$

$F_{i2} = F_{i1} + F_d$ (PA–8433 Series)

$F_{i2} = F_{i1} - F_d$ (PA–8633 Series)

$F_{x'2} = F_{x'1} + F_d$ (PA–8433 Series)

$F_{x'2} = F_{x'1} - F_d$ (PA–8633 Series)

Where F_1=Carrier Frequency #1

F_2=Carrier Frequency #2

F_{i1}=First IF frequency, receiver #1

F_{i2} = First IF frequency, receiver #2

$F_d = F_1 - F_2$

$F_{x'1}$ = IF crystal frequency, receiver #1

$F_{x'2}$ = IF crystal frequency, receiver #2

F_{x1} = Control crystal frequency, receiver #1

F_{x2} = Control crystal frequency, receiver #2

When the #1 frequency is the higher frequency, the algebraic sign of F_d is changed from plus to minus or vice versa.

SERVICE HINTS and SHOP NOTES

CHASSIS GROUNDS

The chassis of an automobile or truck forms an excellent ground return circuit. It is necessary to use this facility intelligently to achieve maximum efficiency. Less than ½ volt will be lost in the power cables and ground return in a well installed system.

1. Connect the radio equipment ground cable to the chassis, not to the body.
2. Provide an additional connection from battery to the chassis if necessary. Replace worn or frayed ground cables.
3. Be sure all points of connection to the chassis are of the largest possible area of metal-to-metal contact. Clean off undercoating, oil, dirt and corrosion.
4. Use solder with a non-corrosive flux as a corrosion deterrent at the connections.
5. Periodically check and clean all terminals and contacts to prevent excessive voltage drop at loose or corroded terminals.

Ground extension cable kits are available if required but full use of the chassis will normally make them unnecessary.

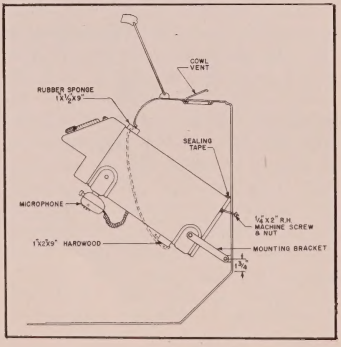
COAXIAL ADAPTER

A coaxial right angle adapter, Type M-359, Motorola Part No. 28A48250, has been added to the cable kit for all front mount versions of the Uni-Channel Sensicon Dispatcher. Installation is simplified and sharp cable bends are avoided by permitting the antenna cable to run parallel to the housing.

UNI-CHANNEL MOUNTING

The versatile front mount version of the Uni-Channel Sensicon Dispatcher is adaptable to many unique and advantageous mounting positions. The above pictured installation shows an installation made in the center dash of a 1951 Plymouth by the Miami Taxi Meter Company illustrating one of the many variations possible.

To accomplish this particular installation, the center dash panel, designed for a broadcast receiver,



was removed. The rear installation bracket, supplied with the unit, is mounted approximately 1-¾" up from the firewall bottom with #12 x 1-½" sheet metal screws. After securing the housing to the bracket, additional rigidity was obtained by drilling a hole for and inserting a ¼" x 2" machine screw from the rear of the housing to the firewall. A 1" x 2" x 9" hardwood block was placed under the housing against the dash and 1" x ½" x 9" strip of sponge rubber was placed between the top of the housing and the dash. A strip of sealing tape over the joint at the rear of the housing precludes any difficulties from rain leakage into the housing on older style housing. The microphone bracket may be mounted at the bottom of the housing or in any other convenient location.

COWL VENT LEAKS

Many auto and trucks, as they age, permit rain to enter the cowl vent. Current model housings for under-dash mounting include a channel to prevent leakage of this water into the housings. Earlier models may, however, allow the rain to seep in. If this difficulty is discovered, the joint at the rear of the housing should be sealed with waterproof tape and one or two small drain holes should be drilled at the rear bottom of the housing. This will virtually eliminate the possibility of any damage to the radio equipment from an incomplete vehicle weather seal.

One outstanding feature of radio communications is its ability to remain in action in the face of fire, floods, severe storms and other disasters. Portable and mobile radio units are unaffected by loss of wire lines or visual communication. However, base stations operating from commercial power may be subject to outages upon loss of the primary power. Two alternatives may be used to cope with such a situation. A mobile unit may be used as the central dispatching station if it provides adequate radio coverage. This is usually accomplished by locating the vehicle centrally at a high point or by providing an emergency elevated antenna to which the mobile unit may be connected. The second alternative is the use of an emergency power source for the existing base station.

GENERATOR TYPES

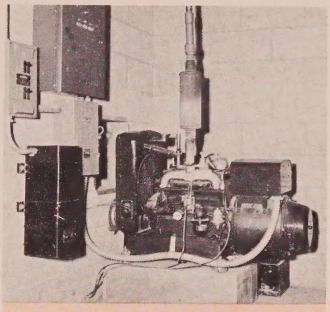
An emergency power source may take several forms, i. e. a battery driven generator set, an engine driven generator or a standby power bus. Experience has shown that the most satisfactory and most reliable radio system is one which includes its own separate generator with a prime mover independent of all external power sources. As an example, a gas or gasoline engine driven generator with adequate fuel storage facilities which supplies power exclusively to the radio equipment is both reliable and practical. With automatic power transfer, communications will be maintained with little or no interruption of service. Even manually switched units will provide the emergency power in a matter of seconds or, at the most, minutes. On the other hand, a standby generator which supplies all emergency power to a building or plant often takes minutes to hours to place in operation and is often already overloaded.

GENERATOR CAPACITY

To determine which generator is required for the specific application, the total load must be accurately computed. The wattage ratings of the radio equipment are normally contained in the service manual for the equipment. In the computations, do not fail to include all auxiliary power drains such as tower lights, minimum required illumination, remote control equipment, test and repair equipment, voltage regulating transformer loss and any other current drains or power losses. The volt-ampere rating will normally be approximately 1.1 time the wattage rating. The generator selected should have output characteristics equal to or greater than the total computed load. A safety factor of at least 10% is recommended. However, the characteristics of the load intermittent or continuous), the duty cycle, and the ambient temperature are contributing factors.

GENERATOR SIZES

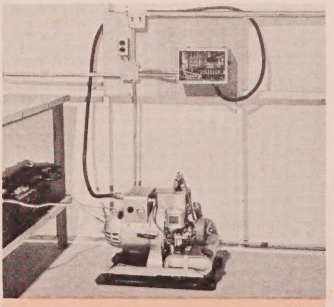
Standard engine driven generators are available in many ratings. The 1 kw. to 3.5 kw. sizes are common and suffice for most applications. The engine is usually available for operation from a variety of fuels. The fuel supply must always be independent. For example, a pipeline system should not rely on the pipeline itself for fuel. A break in the pipeline could interrupt communications just when they are most needed. A 55 gallon fuel storage tank is usually adequate for engine driven generators up to 5 kw. A greater storage capacity is required for larger units, units in locations which are serviced infrequently or inaccessible for extended periods of time and locations subject to frequent power failures.



A 2 kw. engine driven Kohler emergency power plant at the Downer's Grove station of the Texas Illinois pipeline system.

RECOMMENDATIONS

The Motorola Systems Engineering Department has investigated and approved emergency generators built by the Kohler Co., D. W. Onan and Sons Inc., Carter Motor Co., Janette Mfg. Co. and Electric Specialty Co. Since each application requires individual considerations, an overall recommendation for a specific type or specific manufacturer cannot be given. However, the Systems Engineering Department will review any installation in which problems are encountered.

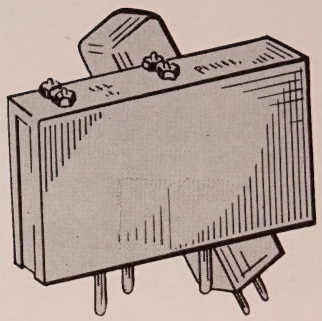


A small emergency power generator used by the Southern Counties Gas Company to provide standby power at a repeater installation.

MOTOROLA'S

new and improved

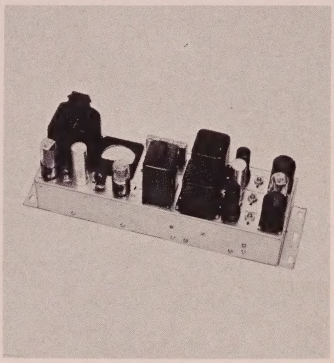
QUIK-CALL



Over five years of intensive and painstaking research combined with comprehensive bench and field tests produced the vibracode system of selective signaling and remote switching. Now, after additional years of the same thorough research, the latest developments in materials, processes and design are included in a new line of QUIK-CALL and Remote Switching Systems.

VIBRASENDERS

The vibrasenders employ the same fatigue resistant materials and components with negligible temperature effects and are basically the same as the previous models. However, phase shifting capacitors have been added inside the case to make the vibrasenders themselves completely interchangeable between sockets for any change in operating frequency or shift in tone utilization. A severe revision of specifications has been instituted to insure precision instrument quality from production line fabrication.



The P-8337-B Transmitter Tone Remote Control Chassis saves on line rental charges by eliminating DC from remote control lines.

VIBRASPONDERS

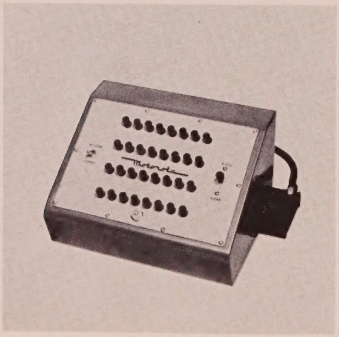
The new lighter, more compact vibrasponders employ spring mounting for the internal assembly which isolates the vibrating reed from any mechanical influence of the chassis. The reed contacts are damped and strengthened to insure longer life and the entire unit is hermetically sealed to prevent entry of moisture or gasses which could possibly decrease the operational life. The "Q", and thereby the selectivity, of the vibrasponders has been radically improved, providing response to only the desired signals under even the worst possible conditions.

FREQUENCIES

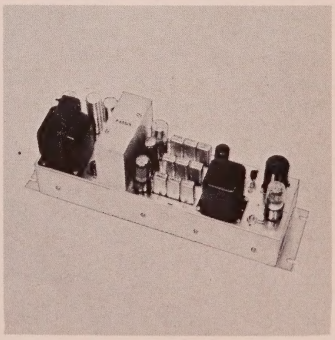
The original channel alloted to the QUIK-CALL and Remote Switching Systems was confined between 100 and 312 cps. The newer models include twelve additional tones from 346 to 1084 cps. which are ideally suited to limited bandwidth systems with inadequate low frequency response characteristics. This also permits additional functions for future expansion as required.

CHASSIS

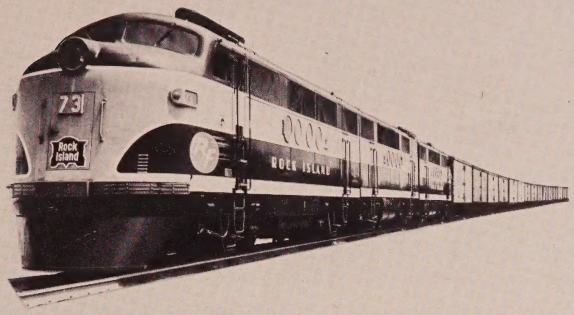
The new transmitter tone remote control chassis and the remote switching chassis operate fully and dependably in less than 250 milliseconds and QUIK-CALL operating time can be correspondingly decreased. The faster acting vibrasponders are also the ideal basis for the advanced Motorola Supervisory Control System.



The P-9270 QUIK-CALL Selector permits up to 32 separate tone combinations to be transmitted individually by depressing a single button for each.



The P-8336-A Remote Switching Chassis provides three separate tone controlled "on-off" switching functions at remote locations.



INSTALLATION OF RAILROAD ANTENNAS ON LOCOMOTIVES

Installation of Motorola antennas on locomotives is in most instances dictated by clearance-profile limitations. With a perfectly matched antenna and transmission line, optimum transmission and reception will be obtained by mounting the antenna at the greatest possible height. Since the permissible vertical elevation is usually limited, the major consideration becomes one of impedance match with the transmission line.

IMPEDANCE MATCH

The importance of matching the antenna impedance to the line impedance is due not only to the desirability of reducing the magnitude of standing waves, but also because of the customary railroad maintenance procedures.

Transmitters and receivers are normally tuned to a standard impedance on the test bench, and installed with no further adjustment. Optimum operation is assured only when antenna installations on all mobile units duplicate the bench standard.

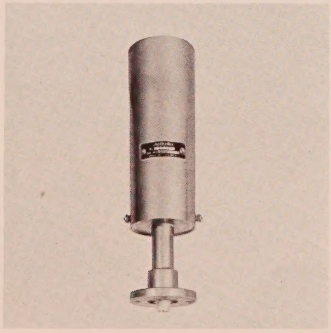
A quarter-wave whip should be mounted on a horizontal conducting plane, extending at least 30 in. in all directions. It should be mounted as far as possible from any other vertical conductors, which might tend to influence the horizontal field pattern. These considerations can usually be met by mounting the antenna directly on the flat or slightly curved surface of the cab roof. Safety requirements dictate that the antenna be sufficiently flexible to preclude its use as a handhold by someone climbing on the roof, or else mechanically strong enough to support a heavy man.

SPECIAL ANTENNAS

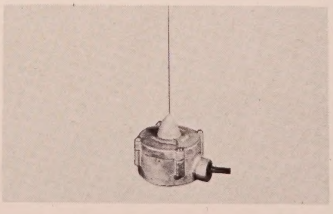
Where clearance requirements dictate less than 18 in. vertical elevation, folded or top-loaded antennas are available. When usable, a half-wave co-axial antenna will provide a gain approaching 3 db over the quarter-wave types. The ideal antenna providing maximum omnidirectional horizontal gain is generally not feasible, since an omnidirectional horizontal gain requires the vertical stacking of elements. Gain in the forward and rear directions could be obtained with any of the common types of broadside or end-fire arrays, but this arrangement is practical only on railroads without curves.

The type of antenna selected must be designed to withstand normal shock and vibration encountered by railroad service. In making the installation, reasonable care should be taken to avoid mounting the antenna at points where excessive vibration exists. Insulators used in the construction of the antenna should have long leakage paths, and be located at low-voltage points on the antenna to minimize the effects of accumulation of dirt and soot. A neoprene cone enclosing the base of Motorola's flexible quarter-wave antennas for railroads performs the dual function of providing a long leakage path, and acting as a vibrator damper to eliminate sharp bending of the whip at the base.

One additional point to remember in making the antenna installation is that the common types of coaxial cable used to connect the antenna to the transmitter employ thermoplastic dielectric materials, subject to softening with migration of the center conductor at bends in elevated temperatures. Hot spots are to be avoided in routing the cable.



The Motorola P-9051 Quarter-wave Rigid Antenna is sturdily constructed for all railroad applications.



The P-8553-E Flexible Condulet Mounted Antenna possesses all the necessary characteristics for a reliable railroad installation.

RADIO REPEATER SYSTEMS

Communications at "line-of-sight" frequencies need not be limited by distance, topography or high ambient noise levels. Relay and repeater systems present a practical and economical solution.

When 2-way communications between vehicle and base station do not satisfy service requirements, either because of extended operating distances or intervening radio path obstacles, some reliable method of closing the communications breach must be devised. A Motorola Radio Repeater system is the bridge which will span the communications gap.

Radio Repeater installations are designed into VHF systems when certain inherent communications interruptions are experienced. These circuit interruptions, which may exist in the form of either serious performance degradation or outright discontinuity, are induced by any of several adverse conditions.

1. When the noise level at the receiver is particularly high, as illustrated in Figure 1.

This is a frequent situation in metropolitan installations where the receiver may be located in close proximity with such RF noise generators as X-ray and diathermy machines, trolley cars, fluorescent fixtures, FM-AM-TV broadcast transmitters and miscellaneous ignition noises. In this case a repeater may be installed at a better receiving point to relay the signal into the congested zone and thereby provide a better signal-to-noise ratio at the base station receiver.

2. When an intervening obstacle lies in the radio path, as illustrated in Figure 2.

The outstanding example of this condition is found in mountainous terrain where the rugged topography represents natural radio wave barriers. To overcome this type of circuit limitation, a repeater is installed atop an intervening summit to receive the transmitted signal and aid it on its way.

3. When extended ranges and/or RF power limitations result in unsatisfactory communications, as illustrated in Figure 3.

In many instances a repeater is the economic solution to the problem of complete coverage in the far corners of an operational area. In such cases, low power transmitters may be employed throughout the system without depriving the remote areas of dependable communications. In other extended range situations where increase of RF power and relative antenna height, within practical limits, cannot recover circuit performance, repeaters are not only an economic elective but also a necessary element of the system.

These circuit discontinuities that may incapacitate 2-way mobile systems apply equally to the "talk-out" signal (transmissions from a base station to a mobile unit) and to the "talk-back" signal (transmission from the mobile unit to the base station). It is frequently true that the mobile signal will be more drastically affected than the base station signal because of the RF power levels. It is the degree of degradation which determines the particular type of repeater installations required to restore continuous communications. Two basic types of repeater systems, currently produced by Motorola, may be used to intercept a radio signal at some intermediate point along its path and re-transmit the intelligence toward its ultimate destination.

Talk-Back Repeaters

The talk-back or 1-way repeater system, illustrated in Figure 4 is most often used as a means of boosting the signal level from a mobile unit to a base station. A fundamental requirement of this type of operation is suffi-

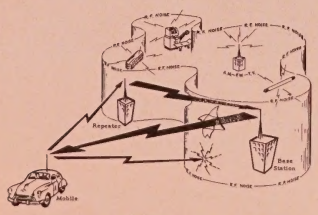


FIG. 1

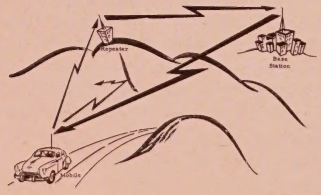


FIG. 2

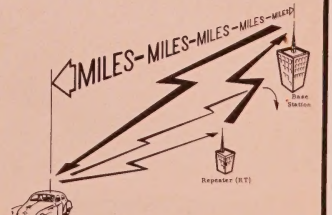


FIG. 3

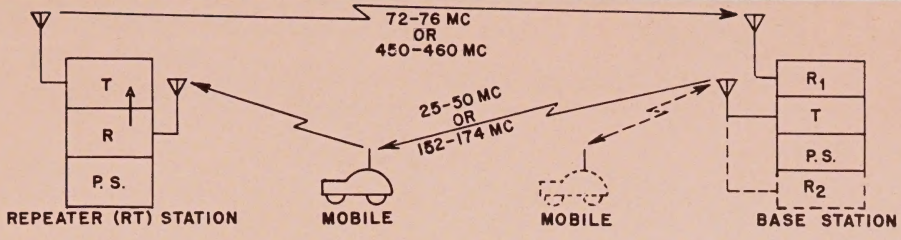


FIG. 4. TALK-BACK REPEATER CIRCUIT (1-WAY)

cient power and range for complete area coverage by the base station.

The repeater (RT) station employs a receiver on the mobile frequency and a transmitter on the repeater frequency. Reception of a mobile signal actuates a squelch relay, automatically turning on the repeater transmitter and retransmitting the intelligence from the mobile unit. At the base station, the primary receiver is on the repeater frequency and the transmitter is on the mobile frequency. Frequently a second receiver is added to the base station to receive the mobile signal directly when the mobile unit is within range.

Automatic Repeaters

Figure 5 illustrates a typical automatic or 2-way repeater system. This type of operation is employed where signal assistance is required in both directions. The Repeater (RA) Installation consists of two complete radio cabinets, a Base (RA) Station which is similar to a conventional remotely installed base station, and a Repeater (RA) Station which performs the functions of remote control over a radio link. The Repeater (RA) Station transmitter and receiver both operate on the mobile frequency. The receiver contains a squelch operated relay to control the Repeater (RA) Transmitter and the Base (RA) Station transmitter is in turn controlled by the Repeater (RA) Receiver. However, to facilitate the necessary "break-in" operation and network supervision, the Repeater (RA) Station transmitter and receiver are on different frequencies. The Control Station may interrupt transmissions from the Repeater (RA) Station by transmitting on its repeater frequency. As in the case of the talk-back repeater system, a second receiver, on the mobile frequency, may be added to the control station for reception when the mobile unit is within range.

Composite Systems

Combinations of these basic types of repeaters may be used for relay stations, point-to-point duplex radio circuits, mobile relay systems and other special applications. Each installation, however, requires engineering evaluation to determine location, frequency, power and antenna type for each unit. Further system details and equipment descriptions are contained in a technical bulletin, TIC-0207512, available from the Technical Information Center.

Frequencies

Motorola manufactures radio equipment in five frequency ranges for use as or associated with mobile communications. Equipment in the 25-50 mc, range, although available for mobile communications, cannot be licensed for repeater or relay operation. The 72-76 mc. range, however, is open for relay and repeater operation only. All services except taxi, low power industrial and similar applications may utilize these frequencies when they do not present interference to television reception. The 152-162 mc. range is available for mobile communications, repeater stations (for all public safety services except special emergency) and relay stations (for police point-to-point communications only). The newly opened 450-460 mc. band may be used by practically all services for repeater applications and by police for point-to-point communications. Microwave systems are available for use with any system in any type of service.

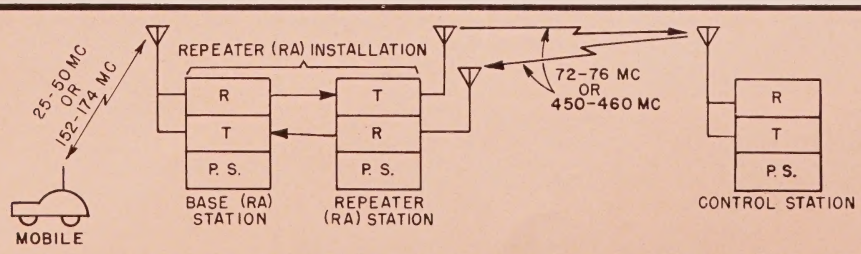


FIG. 5 AUTOMATIC REPEATER CIRCUIT (2-WAY)

TRANSMISSIONS.....

About Motorola 2-Way Radio Users

HUNGRY, MAYBE? . . . . .

A nipping fugitive caused lacerations to the ears of the law in St. Paul, Minn. when Patrolman William V. Glass tried to subdue him. The patrolman had been called by a taxi driver, Edwin Pavik, because the man had refused to pay a $1.75 cab fare. The patrolman suggested that the displeased customer settle the matter by paying the bill. With that the man jumped on him, fastened his teeth to his right ear and began scratching and hitting.

The cab driver, meanwhile, ran to the street and used the patrol car 2-way radio to summon reinforcements.

The patrolman laid his club to his opponent's skull. The man got away and again fastened his teeth into the policeman's left ear. Another skull crashing and the man finally succumbed before assistance arrived.

Sheriff F. E. Lucas of St. Clair county, Michigan displays his new Motorola "Handie-Talkie" portables. Lucas is a past president of the National Sheriff's Association and is now a member of its Board of Directors.

FIDOS FINALE . . . .

New York State's largest township, Brookhaven, which sprawls over nearly 400 square miles across Long Island, now catches dogs by Motorola 2-way radio, the *New York Daily News* reported recently.

Vincent Cardamone, deputy dog warden, who gets many of his calls via the town police 2-way radio system told how the equipment is saving "many hundreds of miles of traveling." Although the mutts are often not waiting for the truck to arrive, and Cardamone sometimes has to crawl under porches or track through swamps to retrieve them, he says the work is greatly simplified as a result of the Motorola equipment.

LAST ROSE . . .

Lyman Rundlett, Motorola Communications Engineer, reports that only one contractor is still working on the east coast Chesapeake Bay Bridge project. Bethelehem Steel Corporation, in its finalizing activities, are using a "BY" type base station and 14 mobile units. One of the supervisors reported: "One more bridge job like this and these bridge men won't be able to work without radio." Other groups that used Motorola equipment on various aspects of the project included Frederick Snare Corporation, J. Rich Steers, Merritt-Chapman & Scott Corporation and the Savin Construction Corporation, all contracting engineers.

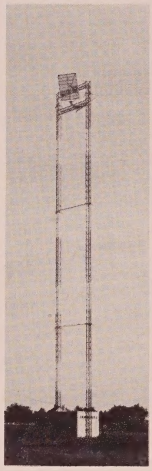
ROUGH RIDE . . .

Sam R. Kennedy, road commissioner for the County of Los Angeles reports that during a recent heavy snow storm a car in which a Motorola radio was housed was hit by a 12-ton truck. The vehicle was catapulted into a roadside ditch. The radio equipment torn from its mountings was tossed to the far side of the car trunk, denting the framework of the radio. Even with the radio in this condition and the antenna connectors broken, the driver was able to call for necessary assistance.

Microwave Towers Ignore Recent Southern Tornados

A tornadic storm blasting through the southwest during the last week of March left power and land line communications prostrate. Through this area, in which more than 200 persons were killed by the storm, runs the Texas Illinois Natural Gas Pipeline Company microwave relay system which extends between Chicago and a point south of Houston.

Microwave repeater stations along this system withstood the maximum ferocity of the storm. At Searcy, Arkansas, 60 miles northwest of Little Rock, steel cable guy wires used to stabilize a 250 foot relay station tower, were stretched as much as 18 inches. A frame building only 600 feet from the base of the Searcy station tower completely disappeared.



Typical tower of the type that withstood storm.

Although the electric power line to the station went out, emergency standby gasoline driven generators automatically switched on to energize the station, so that the 1000-mile circuit from Lake Michigan to the Gulf remained uninterrupted throughout the catastrophe.

On the Mid-Valley Pipeline Company microwave system, which runs between Longview, Texas, and Lima, Ohio, also a distance of 1000 miles, the storm struck with its full vehemence in the area between Abbyville, Mississippi and Denver, Tennessee, where once again land line communications and power lines were out of operation by multibreaks along the lines. The Mid-Valley microwave system, however, was unharmed also by the storm and communications continued uninterrupted over the entire system.

REGIONAL MANAGERS MEET IN NEW PLANT

Gathered together at the first Regional Managers meeting in the Communications Division's new plant are left to right; first row, Eugene F. Brown, John Jipp, Edmund P. Drozek, Vice-President D. E. Noble, Director of Research John Byrne, P. R. Kendall, and Robert Boyter. Second row, left to right are John F. Fussell, Railroad Sales Manager R. Floyd McCall, Wallace P. Miller, Microwave and Carrier-Control Marketing Manager Arthur L. Reese, Glenn M. Munro, Mobile Marketing Manager Myron E. Whitney, and Douglas F. Ball. Third row, left to right; General Manager John F. Silver, Frank W. Walker, Robert L. Batts, Edward L. Falls Jr., Henry C. Gammell, Homer L. Marrs, Lowell E. White, Horace E. Boylan, Frederick H. Schnell, and Assistant to the General Manager G. Donald Borglum.

MOTOROLANS AT WORK

For your convenience there is listed below a complete directory of Motorola Regional Managers, their offices and territory covered.

REGION 1
HENRY C. GAMMELL
Arizona, California, Idaho, Montana, Nevada, Oregon, Washington, Wyoming, Utah.
Office: 1355 Market Street
San Francisco, Calif.
Phone: MARKET 1-8462

REGION 2
EUGENE F. BROWN
Colorado, Iowa, Kansas, Minnesota, Nebraska, North Dakota, South Dakota.
Office: 817 Kilpatrick Bldg.
Omaha, Nebraska
Phone: WEBSTER 0017

REGION 3
HOMER L. MARRS
Illinois, Indiana, Missouri, Wisconsin.
Office: 1327 W. Washington Blvd.
Chicago, Illinois
Phone: TAYLOR 9-2200

REGION 4
GLENN MUNRO
Kentucky, Michigan, Ohio, Tennessee.
Office: 19142 James Couzens Hwy.
Detroit 35, Michigan
Phone: UNIVERSITY 3-6464

REGION 5
EDWARD L. FALLS, JR.
Arkansas, Louisiana, New Mexico, Oklahoma, Texas.
Office: 3230 Louisiana Ave.
Houston 6, Texas
Phone: LINDEN 7593

REGION 6
HORACE E. BOYLAN
Alabama, Florida, Georgia, Mississippi, South Carolina.
Office: Stallings Bldg., Rm. 601
1829 First Ave., North
Birmingham, Alabama
Phone: 4-4582

REGION 7 L.
HARRISS ROBINSON
Delaware, Maryland, North Carolina, Virginia, Washington, D.C., West Virginia.
Office: 2309 Calvert St., N.W.
Washington 8, D. C.
Phone: ADAMS 5620

REGION 8
P. R. KENDALL
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont.
Office: 540 Main Street
Winchester, Mass.
Phone: 6-2482

REGION 9
LOWELL E. WHITE
New Jersey, New York, Pennsylvania.
Office: 102 Linwood Plaza
Fort Lee, New Jersey
Phone: 8-9100

ON LONG ISLAND

At the annual institute of Fire Chiefs Council of Nassau County held recently at Hofstra College, Hempstead, L.I., left to right Emerson McCully and Charles Mona both of the West Hempstead Fire Department, check a Motorola "Handie-Talkie" portable held by Communications Engineer Wallace P. Miller.

Motorola 2-Way Radio

-Speeds- Materials handling

At **Timken** Roller Bearing Company a dispatcher with the help of Motorola 2-way radio maintains steady flow of material from yards to finishing departments.

Timken's fleet of huge straddle trucks deliver 3.34 more bales per truck, per hour—quickly paying for the Motorola units out of increased operation profits.

The figures are convincing.

Your plant too can beat its own production records with Motorola 2-way radio—saving time, costs, outage and dead mileage—keeping your production lines in gear from dock to dock.

You're right the first time with Motorola.

It costs less to install and maintain, year after year, than all others.

With eight leading developments years ahead of the field, including the famous "Sensicon" sealed selectivity, your investment is safe from obsolescence.

So be ahead and stay ahead with Motorola.

Remember there are twice as many Motorola's as all others combined—with *the reason* built into every one.

Experience Counts! OVER 22 YEARS OF LEADERSHIP IN MOBILE RADIO!

It costs you nothing to find out—from a qualified Motorola engineer. Don't delay! Wire, phone or write for immediate and generous information.

Motorola

Communication and Electronics Division
4545 Augusta Blvd., Chicago 51, Illinois